# COMPUTER-AIDED ROBOT-ENHANCED SURGERY (CARES): AUGMENTED REALITY UTILIZING 3D ULTRASOUND

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## Abstract

A surgeon relies primarily on visual feedback when performing surgery on a patient. Until now, stereographic projections have been used to give the surgeon a three-dimensional view. However these two-dimensional projections are not as natural to the surgeon as a maneuverable three-dimensional view. Thus, by combining the real view (the patient) with the synthetic view (3D graphic models of internal organs or tumors) the surgeon can have what is called an augmented view. The augmented information in the form of 3D geometry will allow the surgeon to have a "see through" view of the patient. So how does one obtain the 3D geometry? A CAT scan is too dangerous to use for real-time viewing, and MRI imaging is too bulky and expensive. As a result, ultrasound is being developed to produce 3D models. Ultrasound offers the advantages of good soft-tissue resolution, portability, and applicability in a wide range of clinical settings with minimal expense. To create 3D geometry from ultrasound data some existing software with either partial or full source code was utilized. In the Dept. of Engineering at the University of Cambridge a program called Stradx was created in the C programming language. Stradx has the capability to transfer the ultrasound scans (B-scans) from an ultrasound machine to a PC running Linux. It can then manipulate these scans using position data to create a crude 3D model. At MIT's Artificial Intelligence lab a program named 3D Slicer was developed to display both the stereographic images and the augmented environment on the same display. The main reason 3D Slicer is of interest for 3D ultrasound is because it includes the ability to track movement (in our case surgical instruments) in the augmented view. Therefore upon discovering and understanding how these two tools work, it made sense to link the two. To make this possible a conversion program was written in the C programming language to convert the data from Stradx (Geomview format) to 3D Slicer (VTK format). The result is an environment of 3D ultrasound geometry integrated with a real view which can update the image as the surgeon's instrument is being moved.

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## Category

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